ROINN NA MARA

# FISHERIES RESEARCH CENTRE REPORT FOR 1993

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Fisheries Research Centre, Abbotstown, Dublin 15.

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# INTRODUCTION

## *DIRECTOR'S FOREWORD - David de G Griffith*

Work carried out at the Fisheries Research Centre in 1993 reflects the impact of the first full year of support funding from the EC STRIDE initiative. As highlighted in the 1992 Report, the extra £2.02 million allocated to FRC (75% provided by the EC) enabled us to initiate or expand, in support of Irish marine-based industries, a broad range of scientific activities in the fields of marine fish stocks, aquaculture and the environment.

The 1993 programme enabled by this extra research funding, as described in the following pages, is already yielding benefits on a national scale. More working contact with industry, increased data acquisition and big improvements in our analytical and reporting capabilities have enabled the FRC to provide a better service to management which has greatly strengthened Ireland's hand in negotiating for quotas and other benefits. The improved facilities have also led to an increase in our success rate in applying for European research funds.

The success of STRIDE has demonstrated the value of a realistic scale of financial investment in a national programme of scientific R & D (research and development). Financial commitment must be maintained at the same level, or increased, if the benefits - already emerging - for our marine-based industries are to achieve their full impact in the years ahead.

## *THE STRIDE PROGRAMME - John Browne and Jacqueline Doyle*

The capital expenditure part of the programme has now been completed. The placing of a contract for a Statistician in December 1993 completed the employment phase of the programme and the 23 employment contracts with their associated running costs were due to run until the end of 1994.

The greatest general impact has been from the group of projects in the information technology (IT) area, the computer upgrade, satellite imagery and the provision of a geographical information system (GIS). This has resulted in the routine generation of charts and maps for reports and greatly improved analysis and display of the increased flow of complex data being generated by the many elements of the STRIDE measure.

The decision to implement the change to a full relational database will greatly enhance the capability of FRC to provide advice on its areas of responsibility in a more efficient and integrated fashion. The provision of a full wide area communication network (WAN) will enable the Centre to play a prominent role in international research and development.

Monitoring of marine algal blooms and the testing of shellfish for toxins detected cases of toxicity on the west coast. This programme, now in its 11th year, has succeeded in ensuring that no cases of human illness resulting from the consumption of Irish shellfish have been reported. The work has been extended, with STRIDE funding, to include a survey of algal cysts in marine sediments together with oceanographic studies of the factors influencing algal blooms. The results of this work are applied to improving the precision of identifying and forecasting occurrences of potentially hazardous algae.

STRIDE funding has enabled the marine chemistry section to expand its activities. A new chromatography laboratory was commissioned during the year and a Gas Chromatography Mass Spectrometer has been added to the equipment. The report of this section (page 16) covers a very wide range of environmental monitoring including heavy metals, nutrients and organochlorine residues.

The STRIDE Monitoring Group held a meeting at FRC in September to make an evaluation of the work in progress and the impact of the STRIDE initiative on the scientific effort and its value to development of marine-based industries.

## *STOCK ASSESSMENT - John Browne*

The provision of expertise and the upgrading of facilities under the STRIDE programme made a major contribution to the work of the stock assessment section in 1993. The assessment database is now more robust with the extension of data collection from the ports to onboard fishing vessels. The collation of data is being radically restructured to enable the section to make use of the sophisticated methods of data manipulation and display now available at FRC.

The areas of stock assessment have been significantly strengthened by the provision of Fleet Assessment Technicians. This has been a particularly successful initiative, with a greatly increased flow of information to and from fishermen and a significant improvement in the quality of the data collected.

An economic evaluation of fishing in the Irish Sea and a research programme on the argentine *Argentina silus,* both funded by the EU FAR programme, were completed in 1993 and the reports submitted.

A new investigation of demersal stocks off the west coast was initiated in 1993.
Demersal stocks in general in the areas investigated are declining while pelagic stocks remain strong.

Salmonid research in 1993 concentrated on determining the status of stocks and the level of exploitation by various methods. Support to the ongoing sea trout research programmes required a large commitment in terms of time and resources.

## *AQUACULTURE AND ENVIRONMENT - Jacqueline Doyle*

There was a significant increase in the production of farmed salmon from 9,000 to 12,000 tonnes, despite losses due to novel diseases during the year. Fallowing strategies augmented by harrowing of the sea bed have been introduced to break disease cycles. Single bay management plans are being encouraged where there are multiple farms

Precautionary measures have been taken in the light of the posited connection between the infestation of caged salmon by sealice and the decline in sea trout stocks in Galway and Mayo rivers. This issue has continued to receive maximum attention, including a concentration of manpower resources in the sealice monitoring programme. Improved methods of control of the sealice in salmon cages have been introduced.

Two pilot turbot farms on the southwest coast have reported satisfactory growth rates. Trials of brown trout, arctic char and gullspang salmon are being evaluated in the search for possible alternatives to Atlantic salmon. Experiments in cultivation of the Japanese scallop *Patinopecten yessoensis* have been terminated following mortalities in the broodstock. Proposals to introduce two species of sea bass are being evaluated by the ICES Working Group on Introductions.

## *ICES 81st Statutory Meeting*

Ireland was host to the 81st Statutory Meeting of the International Council for the Exploration of the Sea. The Statutory Meeting, held annually in the autumn in different member countries, is the major gathering of scientists engaged in marine research. ICES co-ordinates scientific work on marine pollution, fish stocks, oceanography and in mariculture. Nineteen papers were contributed to the meeting by FRC staff (details on page 25).

In addition to its function of bringing international expertise to bear on local problems, ICES has a key position in the Irish fishing industry as the scientific forum in which fish stocks are assessed and management measures proposed. It provides scientific advice to the EC and member governments and to international regulatory commissions for fisheries and the marine environment

Eighteen countries were represented by 453 participants. One hundred and one Irish marine scientists attended as experts and, besides taking part in the specialist sessions, had the opportunity of meeting their counterparts from other institutions - an opportunity which is of particular value at a time of seriously restricted foreign travel for scientists. Ireland's two national delegates were John Browne and Jacqueline Doyle

The formal business comprised the updating of scientific work in progress, identification of important gaps in knowledge and formulation of co-operative programmes aimed at filling the gaps. The meeting took place in Dublin Castle and all the local organisational work was undertaken by FRC staff. This was the second time that the Statutory Meeting has been held in Dublin and the second time that Ireland has filled the Presidency of ICES. The previous occasion was 1969 under Arthur E J Went. The President of ICES for the term 1991 to 1994 is David de G Griffith, Director of FRC.

# DEMERSAL FISHERY

## *NEPHROPS (DUBLIN BAY PRAWNS) - Paul Hillis, Jim Carroll*

Samples from the Irish Sea comprised 8,106 males and 8,075 females in unsorted catch samples, 2,039 males and 2,814 females in small whole discards, and 1,596 males, 164 females and 12,315 unsexed in landed nephrops, giving a total of 35,109 overall. By-catch species, mainly whiting, from samples of unsorted and of discarded nephrops were passed to the Demersal Section. Preliminary indications were of a landed catch in 1993 of 1,043 tonnes, a substantial decrease on 1992.

Three hundred and eighty-two whole nephrops in three samples were also weighed individually and ratio of carapace length to tail length and fourth abdominal segment breadth measured to allow for checking of length-weight relationships currently in use and for possible future use of samples measured as tails only.

The routine cruise was carried out in the Irish Sea during June-July to survey the population and to obtain research samples which are easier than commercial samples to age by normal carve fitting, at a season when both sexes are maximally available to capture and when relatively little moulting (which makes ageing more difficult) is taking place.

Work was also carried out on the fitting of statistical normal curves to polymodal length-frequency distributions to provide estimates of the mean length and standard deviation of each age-group in order to assess length at age and total mortality. Indications were quite promising for males and immature females, but the ageing of the breeding female component of the population still presents problems.

Irish data were used at the ICES nephrops Working Group at Ostend during February-March to assess the stock, and work on the normal curve-fitting method to age nephrops was presented at the ICES nephrops Study Group at Aberdeen in November.

## *COD, HADDOCK, WHITING, PLAICE AND SOLE STOCKS - Paul Connolly, Helen McCormack, Nicola Donohue*

These stocks were assessed by the ICES Northern Shelf Working Group based on the results of a comprehensive sampling programme combined with research vessel surveys. In 1993, the FRC were appointed species co-ordinators for cod and whiting stocks in Division VIa. For the first time, full in-house assessments were performed using the latest population modelling software, made possible by the enhanced computer facilities acquired under the STRIDE programme. Some 13,000 fish were aged and 150,000 measured from Divisions VIa, VIb, VIIa and VIIg. In general, whitefish stocks in the waters around the Irish coast, continued to be in a poor state.

*Irish Sea (Division VIIa)*
In the Irish Sea, current fishing mortalities remained very high for cod and whiting stocks, with cod reaching a new record low spawning biomass (3,200t). The state of the whiting stock was difficult to predict due to the effects of the introduction of square mesh panels by the Irish fleet in January 1994. Plaice stocks in have declined since 1988 and is now at 4,300t which is below average. The sole stock reached a historic low in 1991 (3,400t) but recovered to 4,900t due to the influence of the strong 1989 year class.

Donegal and Rockall (Division VIa)
Donegal and Rockall stocks were also in a very depleted state because of high fishing rates and the future levels would be very dependent on incoming recruitment. All were at their lowest recorded spawning stock levels in 1993 with cod at 18,000t, haddock 15,100t and whiting 12,900t. The short term forecasts for these stocks indicated that, at current fishing levels, the size of the spawning stocks would remain stable or increase marginally, but that they would still be at critically low levels.

*Celtic Sea (Division VIIg)*
The Celtic Sea stocks of cod at 4,300t, recovered slightly from the historic low levels of 1992 (3,200t) while whiting stock levels were close to average (14,200t), plaice stocks below average (1,200t) and sole stocks recovered slightly (2,300t) from the historic low of 1991 (1,900t).

*Annual young fish surveys*
In the Young Fish Survey Programme, five research vessel cruises were carried out. The Irish Sea Juvenile Plaice Survey, in progress since 1976 used the commercial trawler *Sealgair* and the results indicated that plaice recruitment in 1993 was above average. Irish Sea Young Fish Surveys, begun in 1985, were carried out on the RV *Lough Beltra* in June and September. They confirmed the poor state of the cod stock, but the numbers of juvenile cod and whiting taken indicated incoming recruitment to have been above average. The South Coast Young Fish Survey in July 1993 on the RV *Lough Beltra* made good catches of juvenile cod and hake but, as the survey had been carried out for only three years, it was difficult to draw any conclusions. The West Coast Young Fish Survey using the commercial vessels *Sionnain* and *Dermot Anne* covered the entire west coast in October. Results indicated a good year classes of monk and hake but again the time series of three years was too short to allow predictions to be made. These surveys also collected samples for a number of other projects including dab and squid studies at University College, Cork research at the Martin Ryan Institute, Galway.

## *IRISH SEA WHITING DISCARD PROGRAMME - Paul Connolly, Dermot Kennedy*

The discarding of whiting by the Irish nephrops-directed fleet is a considerable problem in the Irish Sea, with an estimated 2,000t discarded by the Irish Fleet alone. A monitoring programme was set up in 1987 to estimate the level of discarding by the Irish fleet and in the 1993 programme, 1,700 fish were aged and 5,600 fish were measured. The introduction of the square mesh panel into the Irish Fleet in 1994 is expected to reduce the discard levels.

## *HAKE, MONK AND MEGRIM - Paul Connolly, Helen McCormack, David Noone, Nicola Donohue*

The hake, monk and megrim stock monitoring programmes, which were suspended in 1992, commenced again in 1993. Length data were secured from landings and a megrim ageing programme was set up. Data were presented to the ICES Southern Shelf Working Group. During the year, 5,000 fish were aged and 20,000 measured. In the past there have been serious concerns about the levels of misreporting and under-reporting by the international fleets operating off Ireland. In co-operation with the Department's management enforcement section, the FRC produced estimates of landings based on the analyses of logbook and landings data and on reported inspections of foreign vessels while at sea. The results confirmed suspicions of under-reporting by these fleets and the higher estimates of international landings were accepted by the Working Group. The Northern hake spawning stock biomass had decreased continuously since 1987 to a historic low of 110,000t and there was serious concern about the high levels of fishing mortality. Megrim in Sub-area VII and part of VIII showed above average levels (114,700t) in 1993 while monk (*L. piscatorius)* levels had been decreasing continuously to a historic low in 1993 of 33,900t.

## *ELECTRONIC DATA LOGGING SYSTEM - Paul Connolly*

Under the STRIDE programme, five Husky Hunter Data Logging Systems were developed in conjunction with PSSL Ltd. and ATLAS Computing Ltd. Each unit is composed of a hand held data logger attached to an electronic measuring board and scales. The system permits the rapid measurement of samples by one person and can be used at sea. There is no need for writing as the data are stored on files in the logger. When work is completed the data are off loaded to a computer and can be checked and exported into the appropriate data bases. The systems were ready to operate at the end of the year.

## *WEST AND SOUTH WEST COAST NON ASSESSED STOCKS - Maria Doherty, Paul Connolly, David Noone and Nicola Donohue*

This STRIDE-funded programme was set up to examine stocks of cod, whiting, haddock, plaice and sole off the west and south west coasts Divisions VIIb,c and VIIj,k. These stocks have not been previously assessed and are presently subjected to precautionary TAC's in the absence of any analytical assessment information.

During the year, 4,500 fish were aged and 35,000 fish measured. The FRC were appointed species co-ordinators for these species with the Southern Shelf Demersal Working Group, which was attended in Copenhagen in September 1993. These stocks were discussed and included in the Working Group Report for the first time. Data on discards were collected by the STRIDE Fleet Assessment Technicians (FATs).

An ageing unit was established to process the otoliths collected from the new stock monitoring programmes. A new technician joined the unit and, after a period of training, took charge of the ageing and sampling programmes.

Two young fish surveys were carried out under the programme, one in Galway Bay/Aran Islands on the *Lough Beltra* in July. The other covered the west coast and is mentioned above under *Annual young fish surveys.*

The group also participated in three surveys carried out off the west coast. The UK research vessel RV *Cirolana* conducted a groundfish cruise off the south and south west coasts in March and the commercial trawler *De Linn* conducted an argentine survey in April and September. Two project review meetings were held at the FRC (March and December 1993) at which the work programme and progress of the project were discussed by an external supervisor from the UK.

## *DEEP WATER FISH OFF THE WEST COAST - Ciaran Kelly, Paul Connolly, John Molloy.*

This project, begun in October 1992, is a STRIDE-funded postgraduate studentship supervised jointly by the Department of Zoology, University College, Dublin (Dr John Bracken) and FRC (Dr Paul Connolly).

Two deep water sampling surveys were carried out in the area of the continental slope to the west of Ireland and Scotland for two weeks each in April and September on the Killybegs trawler *Mary M* at depths from 400 to 1,200m. Dr John Gordon (Scottish Association for Marine Science) who is regarded as the leading expert on deep water fisheries visited the FRC in August and gave a seminar on deep sea fishes. He also took part in the September survey and validated the identification of species. This cruise indicated the existence of one of the best deep water fishery in this area, with a stable market available for the produce in Lorient in France. If the catch rates prove sustainable this area holds great promise as a new fishery.

Following analyses of the samples, five species have been selected for further study. These are the grenadier, forkbeard, black scabbard, redfish and smooth-head. A total of 19,000 fish have been measured and 4,061 otoliths have been taken. Ms Sarah Swan (ageing technician) of the SAMS, Marine Laboratory visited the FRC and assisted in examining grenadier otolith sections and comparing age readings.

# PELAGIC FISHERY

## *HERRING - John Molloy, Liz Barnwall*

*Celtic Sea and ICES subdivision VIIj - (south and south west coasts)*
The stock in this area was assessed, as in previous years, on the basis of a detailed sampling of the catches during the main season (October-February) combined with an acoustic survey. The acoustic survey was again carried out on board the Northern Ireland research vessel *Lough Foyle* and consisted of two cruises designed to obtain an estimate of the abundance of the autumn and winter spawning populations. The results of the 1993 surveys appeared to indicate a decrease in the overall abundance of the stock and, together with the reports from the fishermen, created some concern for the fishery. It has not been possible in recent years to obtain an accurate assessment of the stock from this area, mainly because of doubts about the accuracy of the total catches - as distinct from the total landings - and also because of difficulties in interpreting the results of the acoustic surveys. In an effort to obtain estimates of quantities of herring which were discarded at sea and not landed, fleet assessment technicians made a number of trips on board commercial vessels during the season. A young fish survey - designed to provide indices for recruitment of demersal as well as pelagic fish - was carried out in Division VIIj by the *Shannon.*

*ICES Subdivision VIaS and VIIb - (west and north west coasts)*
The herring stock in this area cannot be analytically assessed at present because no fishery-independent surveys have been carried out for a number of years. The state of the stock is, however, monitored by means of a detailed sampling programme, as in the Celtic Sea and Division VIIj. In this programme fish are examined for length, weight, sex, maturity and vertebral counts. The available information suggests that the stock is in a healthy condition and not subjected to over exploitation. The young fish survey, already mentioned in the previous section, also covered the stocks in this area. The survey was carried out by two vessels the *Shannon* from Dingle and the *Dermot Ann* from Greencastle. Information on discards was also collected.

*ICES subdivision VIaN - (west of Scotland)*
The stock in this area is mainly assessed by acoustic and larval surveys carried out by the UK. Ireland, which has a valuable quota in the area, maintains a detailed sampling programme on catches. The stock continues to be reasonably stable and in a healthy state.

*ICES subdivision VIIaN - (Irish Sea)*
The fishery in this area by Ireland is, at the moment, conducted at a very low level. Detailed sampling of landings is carried out and information on the levels of discards taken during the nephrops fishery is collected. The relationship between the herring stocks in the Irish Sea and those in the Celtic Sea should be studied in more detail as it appears that there is considerable mixing between the various stocks.

## *MACKEREL - John Molloy, Liz Barnwall and Dermot Kennedy*

The western mackerel stock is assessed mainly on the basis of international egg surveys carried out every third year. No surveys were carried out during 1993 and so the assessment was based on the results of the 1992 surveys. The stock was considered to be in a healthy state and had increased in recent years because of a number of good recruiting year classes. This was reflected in increased TACs which in 1994 were the highest set for the fishery. Again the young fish surveys were used to produce an estimate of abundance of juveniles. Mackerel were again tagged by the Norwegians off the south west during May.

### *ARGENTINE - Michael Ronan, Jim Daly, John Molloy*

This project, which was part-funded by the EC under the FAR programme, was completed towards the end of 1993. Its purpose was to obtain biological information on juvenile argentines which is considered necessary for accurate assessment of the adult stocks. It should be pointed out, however, that in recent years no Irish fishery had in fact taken place due to difficulties in locating fish and in disposing of the catches.

A number of surveys were carried out in 1993 both on research vessels and on chartered commercial vessels. Considerable data were collected on the location and abundance of juvenile argentines and on their biological characteristics - length, weight, sex, maturity. Further data were collected on feeding behaviour and fecundity. Studies were also undertaken on morphometric variation between argentines from different areas to obtain information on stock identification. The structure of the otoliths of juvenile argentines was also studied with particular emphasis on the establishment of daily growth rings.

### *TUNA - John Molloy, Niall O'Maoileidigh, Liz Barnwall, Frances Bermingham*

The Irish Tuna fishery has become very important in recent years and in 1993 sixteen vessels, mainly from the southwest coast, landed catches worth over £3 million. The fishery has become important, not only because of the value to the local communities, but because of the possible impact which the use of gill nets may have on marine mammals - mainly dolphin - and on other fish. Biological investigations were continued on length and weights of fish landed at Castletownbere and Dingle. One Fleet Assessment Technician (Frances Bermingham) took part in a two-week commercial trip to record biological data and observations on bycatch. The results of the sampling programme were presented at a meeting of the International Commission for the Conservation of Atlantic Tuna (ICAT) held in Madrid and also at a meeting of a study group on the Ecological impact of Tuna draft netting in the north east Atlantic which was convened by the Scientific and Technical Committee for Fisheries of the EU.

## SALMON, TROUT AND EEL

### *SALMONID FISHES - Niall O'Maoileidigh, Bernard Doolan, Anne Cullen, Tom McDermott, Nigel Bond*

*National microtagging programme*
A total of 365,000 hatchery-reared and 4,750 wild salmon smolts and 6,600 sea trout smolts were released in the spring, all from stations on the west coast.

Tagging is carried out in as many hatcheries as possible in a given year to provide fishery and hatchery managers with information concerning the return rate of their stock. These include Cong , Casla , Delphi , Screebe. Like the ESB, many of these hatcheries are attempting to establish suitable genetic stocks for these systems and the tag information is essential for identifying appropriate returning brood stock for stripping and cross fertilisation.

Assessment of the tag recoveries indicated that the impact of the Faroese longline fishery on Irish stocks was small and that in the event of its closure the added return to Irish waters would be between 1,000 and 2,000 fish.

The impact of the Greenland fishery is more serious, particularly as it intercepts salmon which are likely to return in the early months of the year as large, two sea-winter fish (2SW). Although the total salmon catch was very low , 80 tags were recovered in total from this fishery in 1992 compared to only 32 in the previous year. This represents 260 Irish salmon in the entire fishery. Approximately 200 of these fish were from River Shannon releases. Considering the low number of 2SW salmon returning to the Shannon, this number represents a significant

proportion of this section of the stock. From 1993 on, the Greenland quota will be bought out by international concerns in an attempt to increase the returns of salmon spawning rivers.

The number of microtags recovered in the homewater fishery was 10,500. Their distribution indicated a 2% return as broodstock from smolts reared at Parteen hatchery with the commercial catch accounting for a further 1.5% of these reared fish. Drift net exploitation of the Burrishoole and Shannon stocks accounts for between 58% and 67%, a reduction from the figure of 80% recorded in the early 1980s. It is likely that low salmon prices and a perceived low stock have resulted in a lower fishing effort. Returns to most rivers in recent years have been good and the stock level is relatively high.

*River Shannon Salmon Rehabilitation Programme.*
This is a major programme aimed at rehabilitating the salmon run of the River Shannon. In 1990, the Electricity Supply Board (Hydro Section) took the initiative to convene a management group comprising of ESB management and representatives from the major research centres: FRC, Central Fisheries Board, Salmara, University Colleges Galway and Cork, and Office of Public Works.

The FRC is responsible for assessing marine performance and exploitation, and subsequent survival back to freshwater of the entire enhancement stock. This work includes an assessment of the relative performance of specific genetic groups being developed for future enhancement.

*Video Analyses of Fish Passes*
In order to obtain a valid estimate of the number of tagged and untagged salmon entering freshwater, FRC and the ESB have installed a video counting system in the fish passes at Ardnacrusha and Leixlip. Traditional electronic fish counters only provide information on the total number of salmon entering these rivers. The data from the videos has validated the records of the electronic counters and has provided much information on the behaviour of salmon when ascending dams. This pilot programme has shown that the most accurate way of assessing the numbers of ascending salmon is by a combination of video analyses and electronic counting. At Ardnacrusha in 1992, 2,431 fish were observed on video, comprising 792 tagged salmon indicating their hatchery origin while 1,639 were from wild stock. The wild fish did not appear until May, but otherwise the proportions of wild to hatchery were similar from month to month.

*Salmonid telemetry*
Studies are in progress in:

The Lee/Sullane system to assess the behaviour of returning hatchery-reared salmon transplanted to the upper system to spawn.

The Erne system to assess the behaviour of returning hatchery salmon in relation to the fish pass at Kathleen's Falls, Ballyshannon.

The Moy system to assess the length of time returning adult salmon remain in the lower river and estuary and are subject to exploitation. This is part of a larger co-operative programme involving other research organisations on the Moy system.

*Application of Remote Sensing to High Seas Distributions of Salmon Stocks*

This technology is being applied to analyse sea surface temperature profiles in relation to high seas catches and coastal catches of salmon. This will provide information on the distribution of salmon stocks relative to temperature fronts, nutrient concentrations and oceanic currents. Preliminary investigations have indicated associations between seasonal warm water fronts and the catches of salmon in the high seas fisheries.

## *PHYSIOLOGY OF SALMONID SMOLTIFICATION - N. O'Maoileidigh and Mark Harvey*

A comprehensive study into the physiological processes involved in the parr to smolt transition has been in progress since 1991. This is a post-graduate studentship funded under STRIDE and undertaken in co-operation with the Zoology Dept. UCD, under joint supervision with Dr. T. Hayden (UCD). Samples have been taken of salmon, sea trout and brown trout from many rivers in the West of Ireland. Ability to osmoregulate was shown to vary with size, small smolts being more susceptible to mortality in sea water challenge tests. The results confirmed the previous year's observation that ability to osmoregulate did not vary according to the place of origin.

## *SEA RANCHING OF SALMON - N. O'Maoileidigh, Nigel Bond and Gerard Rogan*

Numerous requests and proposals for ranching of salmon have been received by the Department of the Marine in recent years. It is essential that the full implications of ranching are understood before these proposals can be considered on any large scale basis.

Pilot ranching schemes have been established on two rivers in a project funded by STRIDE. Experimental groups of tagged salmon have been released and returned in 1993. Full adult traps were placed on both rivers to capture all ascending salmon and to prevent the ranched fish from entering the upper system to spawn. The ranched fish provide extra angling stock in the lower reaches of the rivers while the excess will be used for commercial sale and broodstock. The performance of each release group will be assessed to establish the most suitable ranching stock.

Micro tag recoveries for the first release of salmon smolts to the Bunowen River indicated approximately 2% return to the river from the release groups. The highest returning group were derived from a Bunowen X Cong cross with Cong progeny also doing well. The returns from the Bunowen X Bunowen cross did poorly. This appears to be the case for many first time crosses when both parents are of wild origin.

## *FRESHWATER EEL - Christopher Moriarty*

Since 1980, FRC has been the centre for monitoring catches of young eels all over Europe, as part of the programme of the Working Party on Eel of the European Inland Fisheries Advisory Commission. This exercise has shown that catches have declined drastically throughout the eel's range: from hundreds of tonnes to tens of tonnes in rivers entering the Bay of Biscay and virtually disappearing from northern Germany. The average catch for the stations monitored throughout Europe has been reduced by 80% in the course of the ten-year period ending in 1992.

Newly arrived elvers, ascending the River Shannon at Ardnacrusha, were very scarce in 1993 and 1992, compared with runs amounting to 2 tonnes or more in the early 1980s. In the River Erne, by contrast, runs have varied greatly but without any overall downward trend being observed. In the Bann, a downward trend has been apparent, but less dramatic than in the Shannon. No satisfactory explanation for the decline has been put forward, though the strongest indications are that the main factors lie in variations in the direction of the Gulf Stream.

The effect of this period of poor recruitment has not yet been calculated and plans are being drawn up to assemble all available data on eel recruitment, stock and crop in eight countries. The direct contribution of FRC to this effort is to continue the long-term monitoring exercise in Lough Derg and to co-ordinate the international exercise. Advice has also been given on legislative measures to be taken to improve management of the eel fishery in Ireland.

# MANAGEMENT

## *FISHERIES ECONOMICS - Paul Hillis*

The EU-assisted project "Overall Optimisation of Profit in Irish Sea Fisheries: a Management, Economic, Socio-economic and Biological Study" was essentially completed during the year. Most of the work in 1993 at FRC comprised modelling the time-paths of recovery of landings of the main exploited species in the area - cod, whiting, plaice, sole and nephrops, - resulting from varying degrees of effort reduction, either immediate or spread progressively over a number of years. The models took into account the differences in behaviour between catch weight, revenue and profit, starting from two different assumptions as to its current level. The economic future time discounting rate was also modelled, using different rates to reflect government cost-benefit analysis practice (5% per annum), and a much higher rate (25% per annum) to simulate fishermen's decision-making in the catching industry.

Results were interesting; reduction of effort, rather than increase in catch, improved revenue, due to the higher unit price commanded by larger older fish whose proportion rises as a result of effort reduction. Profit will improve more than revenue as reduced effort reduces running costs. In all cases, of course, the problem is the immediate reduction of effort which must precede improved catches in the medium and long term. The application of a time discounting rate reduces the net present value (NPV) - value as perceived now - of sums of money in the distant future, when there will be gains, more than that of sums in the immediate future, which will be losses. This effect is slight with a 5% rate, but quite marked with a 25% rate.

## *EU COMMON FISHERIES POLICY REVIEW GROUP - Paul Hillis*

The Common Fisheries Policy Review Group advised the Minister on the mounting of a vigorous campaign within the European Union to try to improve fishing opportunities for Ireland. These concentrated on trying to obtain greater shares of the TAC set in fisheries where Ireland has an interest, increased assistance with fishery protection, measures to mitigate effectively the increased pressure on stocks widely anticipated when the area surrounding Ireland known as the "Irish Box", - from which Spanish and Portuguese fleets are currently excluded, - is abolished on 1st January 1996, among other measures.

Results have been depressing, with no other member-states willing to concede that with 16% of the sea area and 4% of the overall quota Ireland suffers an injustice, since to do so would involve giving away some of their own catching opportunities; the Irish Box will be difficult to retain beyond 31st December 1995, but aid with fishery protection measures looks to be a slightly more hopeful area.

Views from FRC have continued to warn that most stock levels for which we possess information are low and declining, a factor which must be taken account of in contemplating any attempt to expand Irish activity. Furthermore, the EU principle that the ideal regime for managing fisheries involves equal access for all involves a situation which would stimulate heightened competition and reduced incentive to conserve stocks. Conservation regimes, on the other hand, can create stronger incentives to conserve stocks by incorporating features of monopoly thereby making the fishermen feel that their personal efforts at conservation are more likely to be successful.

## *RV LOUGH BELTRA - Michael Gillooly*

The operational year for the vessel started on 8 January and finished on 19 November. The *Lough Beltra* had a very busy year in 1993 with 24 scheduled cruises or periods open to the public, giving a total of 214 operational days. The cruises covered all areas of marine research including fisheries; phytoplankton; physical, chemical and biological oceanography; environmental monitoring; marine geology and technology development. A number of training cruises for third level students from the universities and RTC's also took place. Naval cadets were also, for the first time, given a one day course in marine research techniques on board the vessel.

Major new surveys were undertaken including a survey of demersal stocks in greater Galway Bay by FRC in July, a comprehensive environmental survey of Cork Harbour by FRC in October and a successful survey of sediment fluxes in embayments in the southwest of Ireland by University College Cork and the Canadian Geological Survey. The Geological Survey of Ireland also carried out lengthy sidescan sonar tracks off the west coast of Ireland from Kerry to Donegal in late August. The vessel was open to the public for the Kinsale Boat Show in April and the Dun Laoghaire Harbour Regatta in late May.

The year 1993 represented a major transition in the life of the *Lough Beltra* with a substantial upgrade of equipment using EC STRIDE funds. Significant structural modifications were made and new equipment including a *remotely operated vehicle*, a *towed undulating profiler*, current meters, current profiler and temperature and salinity probes were acquired. A prototype data acquisition system was designed at the end of 1993 and will undergo trials in 1994. In conjunction with this equipment upgrade, the vessel acquired the services of an instrument technician for the first time. The technician ensures that all equipment is maintained and calibrated and so working at its best.

## *ACOUSTIC SURVEYS - John Molloy and John Milne*

This project which is financed by the EC STRIDE programme, was intended to enable the FRC to obtain the equipment and expertise necessary to carry out acoustic surveys on fish stocks around Ireland. Two surveys were carried out on the herring stocks in the Celtic Sea during 1993 using the Northern Ireland research vessel *Lough Foyle*. These surveys were carried out in co-operation with the Marine Laboratory, Aberdeen. A scientific echo sounder - EK500, together with the towed body and transducer, was purchased during the year and was successfully used during the second survey in the Celtic Sea. FRC is now in a position to carry out fully acoustic surveys and to process and analyse the data necessary to obtain stock abundance estimates.

## *FISHING GEAR TECHNOLOGY - Nick Pfeiffer*

Following meetings with BIM and Sean O'Donoghue of Sea Fisheries Control (DoM) to discuss the status of square mesh research and to identify areas where gear selectivity work was needed, two main projects were decided on for 1993. These were to continue fishing trials using square mesh in the Irish Sea and to begin investigations into the selectivity of fixed gears in use in Irish waters.

The level of equipment and facilities available for use on gear projects was reviewed and SCANMAR equipment for use on the RV *Lough Beltra* was purchased from STRIDE funds.

*Square mesh work*

A series of fishing trials were carried out during July aboard the *Juliem* operating from Howth. The objective of the trials was to assess the effectiveness of a square mesh panel for reducing the level of discarding of juvenile whitefish and to evaluate double rig fishing as a means for carrying out comparative fishing trials. The trials were successful in that by fishing a double rig system the catch made by a net fitted with square mesh could be compared against that of a standard trawl. Although a considerable number of hauls were lost due to gear damage the technique was validated and has been used by BIM since in square mesh work off the south coast. A major effort to promote the use of square mesh in prawn trawls in advance of legislation requiring its use was begun in October. An information video on square mesh was produced by the FRC and its launch was co-ordinated with the publication in fishing journals of a number of technical articles by BIM.

*Fixed gear study*

The overall objective was to establish the selectivity of the main types of fixed gears in use by the Irish fleet. The gillnetting fleet can be divided amongst the principal target species. The largest number of boats target hake, cod and pollack using monofilament mesh in the range of

100 to 150 mm (4 to 6 inches). Another fishery is developing for monkfish, turbot and crayfish using mesh sizes of around 250 mm (10 inches). This study got underway in May and length and girth measurements were taken at sea for catches of hake and cod made by a gillnetter. Further gillnet catch data were received from the Fleet Assessment Technicians and are being used to build up a database.

A set of fishing trials were carried out during September whereby five different sizes of mesh in the range 33/4 - 6 inches were fished simultaneously for hake and cod off the south coast for a period of 12 days. The trials went very well and assessment of the results was in progress at the end of the year. The aim of the project is to recommend a minimum legal mesh size for use in the different fisheries.

## *REMOTE SENSING IN THE MARINE ENVIRONMENT - David Whelan*

The Satellite Remote Sensing project concerns the processing of satellite images of Irish coastal waters. This project extends the use in Ireland of satellite imagery for monitoring mesoscale thermal and ocean colour features. Sea surface temperatures and suspended water constituent concentrations can be estimated. These wide area surface and near-surface estimates can be compared with *in situ* measurements using Geographical Information Systems. A fast networked microcomputer with a large hard-disk has been purchased for the project.

*Multi-disciplinary study of Waterford Harbour and the Celtic Sea*
The Waterford region is becoming increasingly industrialised and little is known about the likely impact of any resulting pollution on the ecosystem. Future informed decisions concerning the management of river and estuarine resources will require significant research in this area. The remote sensing facility received its first major trial in a multi-disciplinary coastal zone study of the Waterford estuary and the Celtic Sea. Measurements of temperature, chlorophyll, suspended sediments and salinity were made from on board the Research Vessel *Lough Beltra* from the 6th to 10th of June and from the 7th to 10th of July, 1993. One LandSat-5 Thematic Mapper image was sourced for the 27th of June, the nearest and only cloud free day available. Four NOAA AVHRR images were sourced for the 27th of June and the 1st, 3rd and 5th of July.

An examination of the original high resolution image evealed the suspended matter and thermal plume issuing from Waterford estuary. The patterns of near surface suspended sediment transport and distribution around the coastal waters of the southeast coast could be seen.

Low resolution imagery showed that the water in Waterford estuary was warmer than in the surrounding Celtic Sea with temperatures ranging from 15°C to 17°C. A patch of cooler water, between 13°C to 13.5°C, was observed adjacent to the eastern side of Hook Head. The temperature along the coastline to either side of the estuary was the same as offshore in Celtic Sea, in contrast to cooler inshore water further south. The low resolution temperature maps also revealed the location and movements of the Celtic Sea front.

At the end of the year, the high resolution images were being used for other studies of the southeastern coastline. A visible colour composite showed rock formations beneath the surface of the beach-side water in Tramore Bay and the water channel which winds through the mud flats of Back Strand through which three streams flow out to the sea. A reflected infrared composite showed the patterns of wetness of the mud flats.

## *GEOGRAPHICAL INFORMATION SYSTEM (GIS) - Yves Coupez*

*Equipment acquisition*
During 1993, the FRC has acquired under STRIDE funding a comprehensive data management system. It consist of Sybase, a Relational Database Management System (RDBMS), and Arc/info a Geographical Information System (GIS). Both are running under UNIX on two SUN Sparc workstations. The RDBMS is closely integrated with the GIS and PC based front end applications.

The GIS was commissioned in May 1993. It includes an A0 digitising table, an A4/A0 pen plotter and an A3/A4 ink jet colour plotter. The GIS is linked to the FRC PC network through Novell. The GIS software (Arc/info) includes both the vector model and the raster model offering a comprehensive set of tools for both data management and environmental modelling.

The RDBMS was selected in close collaboration with the National Marine Data Centre. It was installed at the end of December.

*Geographical reference data*
The FRC is acquiring with STRIDE funding geographical reference data such as coastline, bathymetry, wreck position, and river network. Due to restrictions imposed by the availability of data in digital form from the Ordnance Survey and the high cost of Ordnance Survey copyright policy, the FRC has promoted a join venture to digitise the Admiralty Nautical Charts for Ireland. The other participants in the joint venture are the National Marine Data Centre (co-ordinator), the Naval Service and the BIOMAR project (OPW/TCD). A digitising specification document was drafted by all the participants and a contractor was selected through open tender. The digitising was expected to be completed before the end of June 1994.

A bursary student was employed during the summer to input into the GIS a considerable amount of cartographic reference including:- Map of Europe, ICES rectangles, Statistical rectangles, bathymetry around the British Isles, fishing grounds, meteorological zones, all the rivers of Ireland at 1/1,000,000 scale, the road network, the aquaculture designated areas, fin fish farms position.

*Pilot projects*
Pilot projects, based on the requirements of FRC staff, were undertaken during the second part of 1993. A brief outline of the major projects undertaken is given below.

*Mapping*: Data from the Deep Species Survey, the West Coast Young Fish Survey and the Argentine Survey were reported in various map form. Numerous maps were produced for publications, presentations (ICES conference) and posters.

*Logbook*: Data were transferred from Department of the Marine files into a newly designed database. An extensive exercise of data validation was carried out on the data. A GIS graphical interface was implemented to automate the production of descriptive statistics of the data in the logbook, such as maps of fishing intensity by time period and species

*Aquatic environment monitoring*: Data from the NORSAP survey were used to identify suitable contouring methods. The pattern of sampling stations for future surveys will be laid out to maximise the spatial variation. A method has been developed to map the relative change in chemical concentration levels between successive surveys or relative to a baseline survey.

*Argentina silus*: The work involved the design, implementation and validation of cruise database. The GIS was also used for the production of maps, thematic maps, statistical summaries and graphs with geographic and depth dimensions.

*Finfish farms* The Aquaculture Designated Areas and finfish farm positions were entered in the GIS. Maps of finfish farm licences with sea lice counts and salmon production figures were produced. Applications have been written to assist in examining correlation between lice counts and the distance between farms and river estuaries. The Gowan-Hensey data set has been successfully transferred to the FRC.

*Phytoplankton*: Phytoplankton data were normalised and transferred from the existing dBIII files into a specially designed new database schema and a demonstration prototype written in MS-Access. Summary distribution maps of toxic algae were produced.

*Young Fish survey*: A GIS interface application to a prototype database was developed. Initially the application automates the production of recruit maps and produces simple descriptive statistics on a geographic base.

*Oceanography*: Maps of temperature and salinity were produced on a monthly base from ICES data for years between 1951 to 1991 for the Atlantic Ocean west of Galway.

*Co-operation with Naval Service*
Possibilities of data sharing, joint selection and implementation of a PC front end to Arc/info-DBMS and joint development of applications were discussed with the Navy IT Manager.

### *FLEET ASSESSMENT - John Molloy, Paul Connolly, Frances Bermingham, Deirdre Brogan, Jim Daly, Siobhan Moran and Fiona Woods*

Five graduates, funded by STRIDE, were appointed Fleet Assessment Technicians to collect and examine fish samples both from fishing boats and in local markets. In particular, they engaged in the sampling of discards while at sea and in providing data on the activity of the fleets in each port. They were deployed in Howth, Dunmore East, Castletownbere, Rossaveal and Killybegs

Assessed stocks in ICES Divisions VI and VII, and non-assessed stocks in the west and southwest fisheries were sampled. All data were entered on the DEM 1-4 database. The team spent a total of 216 days at sea. Whitefish, herring, tuna, argentine and nephrops were sampled in connection with the projects reported on pages 4 - 8.

## ENVIRONMENT

### *CHEMICAL MONITORING - Máirín O'Sullivan*

Chemical advice continued to be provided on the management and licensing of the disposal of wastes, including industrial effluents, sewage sludge and dredge materials. This is primarily undertaken through participation in the Marine and Freshwater Committees of the Department. The sites for dredge spoil dumpsites at Malahide and Galway Bay were characterised prior to use. Post-dumping surveys sere carried out in Galway Bay and were planned for Malahide. Benthic characterisation and sediment chemistry were assessed on the Cork Harbour dredge spoil dumpsite in the autumn.

The FRC continued to assist in monitoring the fate of Chernobyl radioactivity in Irish lakes. Fish and sediments were sampled from Loughs Anna, Derg, Finn and Gartan in Co. Donegal, from Easkey in Co. Sligo, Callow in Co. Mayo and Owel in Co. Westmeath and forwarded to the Radiological Protection Institute for radiocaesium measurement. Monitoring results between 1988 and 1992 have been assessed.

The general component of a Quality Manual has been drafted and it is planned to work towards incorporation of sectional components into this with a view to obtaining Irish Laboratory Accreditation Board (ILAB) accreditation.

## *MARINE CHEMISTRY -*
## *Eugene Nixon, Evin McGovern, Denis McLaughlin, Maria Smith, Ailve Rowe and Brige Taaffe.*

Some 600 samples were collected during 1993 for a wide range of chemical analyses. The complexity and scope of the sampling and analyses have increased greatly over previous years as a result of additional personnel and new equipment made possible by STRIDE funding. The completion of a new Chromatography Laboratory and the installation and commissioning of the Gas Chromatography Mass Spectrometer (GCMS) has improved greatly the analytical capabilities at FRC.

*Nutrients in Seawater*
A total of 132 samples were collected and analysed as part of ongoing monitoring programmes of the Irish Sea and Mulroy Bay and west coast productivity studies. Levels of nitrates and phosphates in Mulroy Bay were typical for northern temperate waters. This was the third year to monitor winter nutrient levels in the Irish Sea and although too early to detect trends, levels did not appear abnormally high and year to year changes in open sea levels were small.

*Marine Phytoplankton Toxins*
A total of 216 shellfish samples were analysed by HPLC for DSP toxicity in 1993. Levels were generally lower than in 1992 and only 11 % of samples analysed had combined (OA+DTX2) toxicity of greater than 20 µg/100g of meat. Highest levels of Okadaic Acid and DTX 2 were detected towards the end of July at Killary and Castletownbere respectively. Results from two intercomparison exercises carried out during 1993 suggest that good agreement can be achieved using HPLC methods, but that these methods are not particularly robust and difficult to use as routine monitoring tools. Therefore, it is proposed to develop LCMS methods for the analysis of DSP toxins in shellfish in 1994.

*Ivermectin in Farmed Fish*
Over 80 analyses for Ivermectin in fish tissue were performed during 1993 on samples collected from retail outlets or as a result of requests by fish farmers. Concentration detected in retail samples ranged from not detected to 1.1 µg/kg with a mean concentration of 0.06µg/kg. Level in fish flesh prior to harvesting ranged from not detected to 5.5 and a mean concentration of 0.7 µg/kg. Although the maximum residue level recommended by the EC for animals is 15µ g/kg liver, it was recommended not to harvest fish with levels greater than 1.0 µg/kg in the flesh.

*Mercury Monitoring*
Continuing the programme started in 1992, samples of various species from the commercial catch and shellfish from the major shellfish growing areas were collected and analysed for mercury. This programme is designed to sample the main commercial species landed at the major Irish ports and shellfish growing areas and to use the results for the OSPARCOM's Joint Monitoring Programme and the EC's mercury directives. With the exception of a small number of samples collected late in 1993 all other samples have been analysed.

*Shellfish Growing Areas*
This monitoring programme has been extended in 1993 to include 20 shellfish growing areas with sampling being carried out twice a year in compliance with EC Directive 923. The analyses required include metals and chlorinated hydrocarbons in shellfish and although all analyses are not yet complete, results to date indicate compliance with the directive.

*Co-operative work*
The FRC chemistry laboratory was involved in monitoring and research programmes with a number of outside bodies. These include the monitoring of chlorinated hydrocarbons in marine mammals with University College Cork and the National Heritage Council, the

analysis of nutrients in seawater to be used as tracers in radio isotope studies with the Radiological Protection Institute and the analyses of water and biota following chemical spills into Cork Harbour with the EPA.

*Quality Control*
During 1993 the laboratory participated in a number of exercises designed to monitor and improve the quality of data it produces. These include two EC funded intercomparisons, one on DSP toxins in shellfish and the other an extensive programme on quality assurance in marine monitoring covering nutrients in seawater, metals in sediments and organics in biota. The laboratory also participated in a joint ICES/IOC/OSPARCOM intercomparison exercise on the analysis of chlorobiphenyl congeners in marine sediments and cod tissue. Approximately 10% of the laboratories effort goes towards the analysis of reference materials and quality control.

*Cork Harbour Survey*
A week-long survey of Cork Harbour was undertaken during October. Samples for chemical, oceanographic, benthic macrofauna and algal cysts measurements were collected. Fish, shellfish, sediment and water samples were analysed for priority pollutants (e.g. heavy metals, PCBs, chlorinated hydrocarbons pesticides and PAHs) and by scanning these samples using GCMS to provide information on the range and distribution of contaminants. It is intended that this approach will be applied to one major estuary per year, revisiting each estuary on a 5 to 6 year cycle.

*Method Development*
During 1993 the GCMS was installed and commissioned and, following the recruitment of a chemist to operate this equipment, the range of analyses possible at FRC has increased enormously. Methods for the analysis of PAHs in biota and sediments were developed and combined UVF and GCMS method development for the characterisation and quantification of petrogenic hydrocarbons in marine samples is ongoing. The capability to scan samples for unknowns has resulted in our ability to respond to requests to analyse samples for unknown contaminants following chemical spills in the marine environment as happened on a number of occasions in 1993.

Other methods developed during the year included the analyses of the carotenoids astaxanthin and canthaxanthin in fish tissue. This can help to distinguish between wild and farmed fish. Also, during 1993, methods for the analysis of arsenic in fish tissue were developed. Measurement of arsenic is required under EC directive 923.

## *TRIBUTYL TIN - Colm B. Duggan and Dan Minchin*

The use of tributyl tin (TBT) in anti-fouling treatment was banned by Bye-law in 1987 on boats of less than 25 m, on salmon cages and on all fixed structures. Monitoring of TBT contamination using dog whelk as a bio-indicator showed that the levels had declined significantly since 1987 in those areas where yachts and small boats and salmon cage netting had been the source. In contrast, the levels of TBT had remained high in harbours used by shipping and the larger fishing boats.

## *OCEANOGRAPHY -Terry McMahon and Joseph Wall*

A study of the physical, chemical and biological oceanography of the continental shelf waters west of Ireland was carried out between 16 April and 30 April on board the Russian RV *Professor Marti*. This was part of an ongoing collaborative research programme involving scientists from the FRC, University College Galway and PINRO, Murmansk, Russia. A total of 65 stations were visited at which depth profiles of temperature, salinity, nitrate, phosphate and oxygen were recorded. Continuous measurements of near surface *in vivo* chlorophyll fluorescence and salinity were also made along the cruise track. Evidence for seasonal pycnocline development was found at almost all stations and nutrient data suggested that the spring phytoplankton bloom was close to its maximum. At the Western Irish Shelf Front

chlorophyll fluorescence showed a minimum with levels increasing both seaward and towards the coast.

During May, as part of a multidisciplinary investigation of the north west Irish Sea, CTD and beam transmission profiles were measured at 33 stations. Additionally, surface suspended matter concentrations were measured at every station. Sea surface temperatures were in the range 8.7 - 10.4 °C while the salinity ranged from 24.76 psu at the mouth of the Liffey to 34.09 psu in the central Irish Sea.

Between 6 and 10 June, a collaborative cruise involving scientists from the FRC and University College Galway was carried out to study the phytoplankton ecology of the southern Irish Sea / north east Celtic Sea and investigate the distribution of basic oceanographic parameters ( temperature, salinity, suspended matter, turbidity and chlorophyll) in the Waterford Estuary and its offshore plume. The data from the Waterford Estuary and plume were used as ground truth measurements for the interpretation of a LandSat Satellite image of the area taken close to the time of the cruise.
An oceanographic survey of Cork Harbour was carried out during October as part of an investigation of the water and sediment quality in the area. The survey included measurements of current speed and direction at three locations over a tidal cycle with accompanying CTD and suspended matter sampling at hourly intervals over a tidal cycle. Measurements were also made at 15 stations along the main axis of the estuary.

## *BENTHIC ECOLOGY - Sinead Neiland and Joseph Wall*

Surveys took place to assess the effects on the benthos, and hence the marine environment, of various activities such as aquaculture, sewage and dredge spoil sludge dumping. At the end of the year analysis of the samples was well advanced and the preparation of reports was in progress.

The following benthic surveys were carried out:

*Bantry Bay* to assess the impact on the environment of the intensive mussel farming operations in the Bantry and Glengarriff areas.

*Dublin Bay* to assess the recovery status of the old, disused sewage sludge dump site and to examine the suitability of the new site two years into its operation.

*Aquaculture sites* on the south-west and west coasts in conjunction with the algal cyst mapping project (p. 19).

*The Irish Sea* was sampled on a grid basis as a contribution to a general baseline map in preparation as part of a STRIDE multidisciplinary survey incorporating benthic ecology, oceanography, chemical contaminants and phytoplankton.

A STRIDE multidisciplinary monitoring survey of Cork Harbour and the dredge spoil dump sites was carried out, incorporating benthic ecology, oceanography, chemical contaminants and phytoplankton.

The RV *Lough Beltra* equipped with the ROXANN tracking system, supplied with the assistance of STRIDE funding, was used in the Dublin Bay, Irish Sea and Cork Harbour.

## *PHYTOPLANKTON - David Jackson and Joe Silke*

Monitoring of phytoplankton from areas of aquaculture activity, shellfish grounds and other places of interest continued in 1993. The number of samples analysed was approximately three thousand. The causative agents of DSP toxicity in shellfish, *Dinophysis* species were again recorded at a number of locations on the southwest and west coasts. No significant blooms of other harmful species were recorded in 1993. A minor bloom of *Gyrodinium aureolum* of less

than 1 x $10^6$ was observed in Kenmare Bay in August and low numbers of *Hetrosigma akashiwo* in the same area over the period June - September. No effects were observed.

Routine monitoring for marine biotoxins was carried out throughout the year in the areas at risk. Toxicity, first detected in shellfish on the west coast in 1992, was detected there again and closures were enforced in a number of cases. Toxicity was also detected in the southwest with closures in the Bantry area and adjacent bays.

In addition to the routine biotoxin monitoring, samples from nineteen locations country-wide were analysed for the presence of DSP and PSP toxicity as part of a monitoring programme on the quality of shellfish growing waters under EC Directive 79/923/EEC.

### *MAPPING ALGAL CYSTS IN MARINE SEDIMENTS - Jacqueline O'Mahony*

During 1993, approximately 130 sediment samples were collected from sites on all coasts from Carlingford Lough, Co. Louth to Kindrum Bay, Co. Donegal. Sampling was either carried out on foot at low tide, from a boat or by SCUBA diver. In the samples analysed (5 size fractions per sample) approximately 58 species of benthic microalgae were recorded, comprising benthic diatoms, silicoflagellates and dinoflagellates. Over 21 species of dinoflagellate cysts were identified. Morphometric and photographic data have been collected on most of the species. Cysts were observed in all areas examined, although both the numbers of species found and the dominant species present varied between locations. Cysts of the psp-containing genus *Alexandrium* have not been recorded in the sediment samples examined to date. The most common dinoflagellate cysts were *Lingulodinium polyedra, Scrippsiella spp.* and *Polykrikos schwartzii.*

Sediments associated with imports of oysters from France in early 1993 were also examined for the presence of benthic microalgae in general and dinoflagellate cysts in particular. Over 65 species of microalgae were recorded, of which 20 were dinoflagellate cysts. Some of these cysts resembled those of *Alexandrium sp.* The results demonstrated that microalgae can be transferred inadvertently and may be a vector by which undesirable species may be introduced into Irish waters.

## FISH HEALTH UNIT

### *HEALTH CONTROL - John McArdle, Darrell Clinton, Fiona Geoghegan, Cathy Hickey and Frank McKiernan*

*Shellfish disease surveillance*

The principal task undertaken in 1993 involved examination of shellfish, principally flat oysters, from all the important shellfish growing areas in the country with the aim of obtaining approved zone status, under Directive 91/67/EEC, for all or part of the Irish coast for the list II diseases, Bonamiosis and Marteiliosis. Samples of oysters from the following bays were examined Carlingford Lough, Cork Harbour, Tralee Bay, Galway Bay, Ballinakill Bay, Clew Bay, Blacksod Bay and Lough Foyle. A total of 4903 oysters were examined. Bonamiosis was detected in Ballinakill Bay for the first time in 1993.

*Fish farm inspection*

Most of the salmon and trout farms in the country were inspected and 50% of those sampled for the presence of the list II diseases of fish, Infectious Haemetopoetic Necrosis (IHN) and Viral Haemorrhagic Septicaemia (VHS) to enable Ireland to maintain its approved zone status for these diseases under Directive 91/67/EEC. No cases of these diseases were detected on the 70 farms inspected.

*Export of live fish and eggs.*
Approximately 17 million eyed salmon eggs were exported to a number of countries, including Canada, Chile, Denmark , England, Germany, Portugal, Scotland, Spain and Turkey. Laboratory testing and health certificates were provided to facilitate this valuable export trade. Approximately 200,000 live salmon were also certified for export to France and Spain.

## *VETERINARY DIAGNOSTIC SERVICES - Francis Scullion*

Approximately 81% of the finfish cases handled by the Fish Health Unit involved veterinary diagnostic services. As such, the total casework attended to in investigations of health and disease of farmed and wild freshwater and marine finfish and pet fish was 183 cases (72% farmed, 18% wild and 10% pet fish) involving 4,803 fish. Site visits numbered 46.

Some economically important notifiable diseases were reported or confirmed by laboratory tests in farmed fish. These included *Yersinia ruckeri* (ERM), IPN and furunculosis. The incidences of these diseases have increased in the past year.

Two major aquaculture businesses were separately affected by novel disease processes during the year. One case involved the isolation of an, as yet, unidentified bacterium associated with mortalities of up to 100% in large salmon at sea. A further case resulted in the second annual recurrence of an encephalitis in salmon smolts shortly after they were put to sea, with 100% mortalities of approximately half a million fish over a period of 6 weeks. IPN virus, an unidentified bacterium and an unidentified parasite-like organism have been associated with this problem. Immediate veterinary control measures were instigated in an attempt to contain and eradicate these novel diseases.

A number of possible pathogens including a potential virus isolate have been associated with mortalities of wild coarse fish in Irish rivers.

Other veterinary work in relation to finfish included advising the Department on the safe movement of over 14 million fish under Aquaculture Licence permit and advice to Departmental Aquaculture Licence Vetting Committee in relation to fish health.

## *MICROBIOLOGY/VIROLOGY - Fiona Geoghegan, Catherine Hickey*

Approximately 3,500 fish were received by the Fish Health Unit, the vast majority of which were examined microbiologically and virologically. A large percentage were farmed in origin with a much smaller percentage being either pet fish or wild fish. These were received either for diagnostic or legislative purposes. However, the implementation during the year of Directive 91/67 EEC has ensured that statutory work now accounts for a more significant proportion of the work load than in previous years.

In the course of sampling and inspection, in addition to the isolation of organisms such as *A. hydrophila*, *Pseudomonas sp.*, *Vibrio sp.*, *Flavobacterium sp.*, *Myxobacteria* etc., a number of notifiable diseases have been detected on new sites. *Aeromonas salmonicida* was detected on two previously uninfected sites, with *Yersinia ruckerii* Type 1 being detected on one sea site and one hatchery.

An as yet unidentified bacterium was isolated from market size salmon. It is thought that this organism, which has extremely fastidious growth requirements, has accounted for very substantial mortalities at one sea site. It is hoped that this organism can be named early in 1994.

Virological testing also yielded some interesting results. IPN (infectious pancreatic necrosis) was isolated on four sites - one hatchery and three sea sites. Once again the surveillance programme has shown the absence of the viruses IHN (infectious haematopoetic necrosis) and VHS (viral haemorrhagic septicaemia). These results have been confirmed by conventional virological techniques using two cell lines.

In total, 21 site visits were carried out and 630 fish were examined on site.

# AQUACULTURE

## *SEA-LICE - David Jackson and Dan Minchin*

During 1993 the level of monitoring of sea lice infestations on farmed salmonids was increased. All farms were inspected in April, May and June and again in the autumn and winter. Monitoring at selected sites was continued throughout the summer.

Samples of lice from farmed salmon and wild salmon taken in the summer months are being subjected to testing to determine whether they can be identified as belonging to different sub-populations.

Investigations into the biology and behaviour of the non-parasitic larval stages continued. Larvae of both *Lepeophtheirus salmonis* (the salmon louse) and *Caligus elongatus* from farmed salmon were reared and observed in the laboratory. Experiments suggested that the larvae of *C. elongatus* may be more euryhaline than those of *L. salmonis*. Copepodites of the salmon louse were found in association with the epibenthos at two sites. These preliminary findings suggested that the infective stages of the salmon louse may not be randomly distributed in the plankton and may explain the difficulty researchers have had in locating them in previous studies.

## *SCALLOPS - Dan Minchin*

There is much interest in the culture and ranching of scallops and a number of projects on the west and south-west coasts of Ireland to determine the viability of this approach are underway. The source of the majority of scallop spat is Mulroy Bay and in 1993 there was a moderate settlement, contrasting with the poor settlement in 1992. The settlements are likely to be dependent on ongrown scallops, collected in the Bay, being returned to form part of the spawning population. Dredging within the North Water of the Bay is prohibited in order to conserve the spawning population to enable commercial spat settlements.

Investigations on the growth of native and sown scallops in Valentia Harabour took place in January and their progress will be examined in 1994.

Scallop sowings are under study in Connemara as part of a Concerted Action programme with the EU which involves scallop biologists in Norway, Scotland and France, this programme is scheduled to continue during 1994.

## *SHELLFISH - Colm B. Duggan and Dan Minchin*

*Introductions*

In January 1993, longstanding controlsd on trade in live fish and shellfish were relaxed, following the introduction of the EC Single Market. Large scale transfers of half-grown Pacific oysters *Crassostrea gigas* from France to Ireland began in January 1993. To date, the following non-native organisms have been found on or in some of these oysters: *Crepidula fornicata* (pest), *Mytilicola orientalis* (parasite). *Myicola ostraeae* was found attached to the gills at import, but not subsequently. *Terbellides lapidaria*, and non-native species of *Pomatoceros* and *Aiptasia* were also found. *Ostrea edulis* and *Mytilus edulis* were found attached to *C gigas* and, although native to Ireland, imported stock could serve as vectors of disease. Later importations have been confined to hatchery seed.

*Tributyl tin antifoulant*
A number of Irish bays and harbours, which were found in 1987 to have been affected by tributyl tin (TBT) either from salmon cages, small vessels (yachts and small fishing boats) or large vessels (ships and large fishing boats), were examined in 1993. This was six years after the ban on the use of TBT on net-cages and on vessels under 25 m. The indicator species, the dog whelk *Nucella lapillus,* was examined at the University of Münster, Germany by Drs J Ohlmann and E Stroben. TBT levels have declined noticeably in areas of salmon farming and small boat activity. In Killybegs and Cork Harbour, levels have increased. There is currently no control on the use of organotin on vessels greater than 25 m.

# COMPUTER FACILITIES

## *EQUIPMENT AND SOFTWARE DEVELOPMENT - Kerry Blake and Richard Quinn*

The Local Area Network (LAN) installed in 1992 was further developed and improved. Numerous new services were made available to the users of the system in both the hardware and software areas. A number of additional personal computers were ordered to provide additional access to the network for staff. The Ethernet structure was expanded to provide Ethernet points in new offices and work areas. Specialist equipment for STRIDE projects was researched, ordered and configured this includes such equipment as an RDBMS server for the Geographical Information System. High specification personal computers for the Satellite Imagery and Acoustic projects

A major study into Wide Area Communications was undertaken and, following on from this, installation of a system to provide E-Mail facilities began. This will give FRC full access to national and international bulletin boards of a scientific nature. To date the E-Mail connection is up and running between HQ, Leeson Lane and the FRC and is being used for mail and file transfers via Microsoft Mail and LAN WorkPlace File Express. Personal computers and modems for the Fleet Assessment Technicians were purchased and have been configured to allow data transfer to and from the FRC servers via modem. The FRC will also be able to transfer data and messages to other institutes and EU bodies. Work was carried out on the *Lough Beltra* computer systems and Data Acquisition System. Comprehensive training in the use of the licensed software available to staff was provided over the year.

## *SOFTWARE - Richard Quinn*

*Databases*
The most significant software development has been the purchase and installation of Sybase - a relational database management system (RDBMS). A considerable amount of time was spent discussing FRC data requirements with the Civil Service Central Information Technology Service and with the various Departments that have been through this procedure. Working closely with the Marine Data Centre it was decided to purchase Sybase (also known as SQLServer) because (a) it is closely integrated with the Microsoft Windows products (b) initial cost and the cost of purchasing further licences were competitive and (c) because it is technologically more advanced than the other products in its implementation of the client-server model and in its use of triggers and stored procedures.

Powerbuilder was selected for application development and a Sun Classic computer was purchased to be dedicated to running the database software. At the end of the year software and hardware had been installed.

A program was written to enable data gathered for Irish Sea young fish surveys to be input to a database. This program stores the data in an Access database but will be updated so that the data are stored in Sybase. The data were input over the summer by a bursary student.

The program to input data to the chemical analysis database was rewritten.

A revised program has been developed in consultation with the Fishery Officers for inputting data from the official fishermen's Logbooks.

*Training, Troubleshooting & Maintenance*
Training for staff members was focused on the use of Windows, Word, Excel, Powerpoint and Mail. Two training videos produced by Microsoft for Microsoft Word and Excel were purchased.

A considerable amount of time was spent on troubleshooting users' hardware and software problems. This has included backup for the network manager and solutions to software problems.

*New Software*
The following new software products were purchased :- Microsoft Mail, Microsoft Access, XTree for Windows, Laplink V, Visual Basic, Copies of new versions of Word, Excel, Powerpoint and Access for evaluation and PC Tools For Windows.

*Dataloggers*
Software used to download data from the Husky data loggers to the PC and into a Sensible Solution format had not been completely reliable. The original author of the software was employed to rewrite the programs for the new Data Loggers and the changed Sensible Solution file formats.

### *HARDWARE - Kerry Blake*

The year 1993 was the final period of funding for the purchase of hardware under the EU STRIDE program for Ireland. During this time a number of additional purchases in the area of computer hardware were completed, also the Ethernet cabling was extended and further developed to provide greater access to the network for users. Hardware items for the following applications were installed and established:

RDBMS server for the Geographical Information System.
Satellite imagery
Acoustic sensing
Personal computers and modems for Fleet Assessment Technicians
Data Acquisition System for RV *Lough Beltra.*

## INFORMATION

### *LIBRARY - Mary Moore and Antony McDermott*

The library has undergone some major changes in the past few years.Microcairs ,a library management systems software package has been purchased through the STRIDE funds. This has enabled all aspects of the work to be computerised: ordering of books and periodicals, periodicals check-in, cataloguing, information retrieval, inter-library loans. The borrowing of books is now done by bar-coding and a light pen is used to record the loans.

Current Contents for Agriculture, Fisheries and Environmental Sciences, on disk was also purchased. It comes out fortnightly and is a listing of the contents pages of relevant periodicals. Subject profiles have been set up for staff members who receive a listing of papers in their subject areas on a regular basis.

A cd-rom computer compatible machine is in the process of being installed. Four cd-rom disks have been purchased. They are: (Aquatic Sciences and Fisheries Abstracts) backdated to 1978; *Waves*, the Canadian grey literature database which includes FAO, ICES and Canadian grey literature, *Fish and Fisheries Worldwide*, backdated to 1971, and *Celex*,

European Union legislation. It is now possible to provide a very comprehensive information service .

In 1993, some 150 new books were purchased. A total of 300 inter-library loans were also supplied.

## *PUBLICATIONS AND CONFERENCE FACILITIES - Christopher Moriarty*

Equipment purchased with STRIDE support has introduced a degree of self-sufficiency in in-house publication and has upgraded facilities in the FRC Conference Room. A digital duplicator, a collator and a power stapler allow production of the *Fishery Leaflet* series with improved quality and very considerable savings of time and cost. The Conference Room has been provided with an LCD panel for projecting computer and video images.

## *PUBLICATIONS*

*Fahy, E. Inventory of enmeshing gears in European waters.* European Union, contract PEM/93/11.

*Fahy, E. and P. Gleeson* (1992). A second assessment of the stock of megrim *Lepidorhombus whiffiagonis* in Divisions VII b, c, j and k. *Fisheries Bulletin* 12, 15 pp.

*Fahy, E. and P. Gleeson.* Aspects of the exploitation of hake *Merluccius merluccius* belonging to the Northern stock by fleets based in Ireland. *Fisheries Bulletin* 13, 17 pp.

*Fahy, E. and P. Gleeson.* Catch per unit effort by the joint venture (Irish-Spanish) fleet from 1985 to 1992. *Fishery Leaflet* 115, 14 pp.

*Gillooly, M., Y. Coupez and J. Wallace.* Irish Marine Databases. *Marine and Coastal Databases. Proceedings of the Irish Sea Forum Seminar* Liverpool University. pp 27-43.

*Gillooly, M. & G. O'Sullivan.* R.V. *Lough Beltra*, 1989 -1992. in M. Gillooly & P. Byrne (eds) *Lough Beltra 1989-1991, Proceedings of the R.V Lough Beltra Workshop 1992.*

*Hu, T., A. deFreitas, J. Doyle, D. Jackson, J. Marr, E. Nixon, S. Pleasance, M. Quilliam, J. Walter and J. Wright.* New DSP toxin derivatives isolated from toxic mussels and the Dinoflagellates *Prorocentrum lima* and *Prorocentrum concavum.* in Smajda and Shimizu (eds) *Toxic Phytoplankton Blooms in the Sea.*

*Jackson, D. & D. Minchin.* Aspects of the reproductive output of two caligid copepod species on cultivated salmon. *Invertebrate Reproduction and Development* 22: 87-90.

*Jackson, D. , & D. Minchin.* Lice infestation of farmed salmon in Ireland. In: G. A. Boxshall and D. Defaye (eds) *Pathogens of wild and farmed fish: Sea lice.* London, Ellis Horwood Ltd. 189-201.

*McArdle, J. F., C. Dooley - Martyn, F. Geoghegan, F. McKiernan and H. Roger.* Furunculosis as a possible factor in the decline of sea trout in the west of Ireland. *Fisheries Research* 17 201 - 207

*McMahon, T., D. Jackson and E. Nixon.* Observations of a bloom of *Gyrodinium aureolum* off the southwest coast (of Ireland) during the summer of 1991. in M. Gillooly and P. Byrne (eds) *Lough Beltra 1989-1991: Proceedings of the RV Lough Beltra Workshop 1992.*

*Minchin, D.*, (in press, 1994). Gigantism in the scallop, *Pecten maximus.* in J. C. Aldrich (ed) *27th European Marine Biology Symposium.* (In press).

*McGrath, D., D. Minchin. & D. Cotton.* (in press, 1994). Extraordinary occurrences of the by-the-wind sailor, *Velella velella* (L.), (Cnidaria) in Irish waters in 1992. *The Irish Naturalists Journal.*

*Minchin, D.* Extensive grazing of the prosobranch *Lacuna vincta* (Montagu) on the kelp *Alaria esculenta* (L.) Grev. *The Irish Naturalists' Journal,* 24: 171-172.

*Minchin, D.* Possible influence of increases in mean sea temperature on Irish marine fauna and fisheries. *Biogeography of Ireland; past, present, and future.* in M.J. Costello & K.S. Kelly (eds). *Occasional Publications of the Irish Biogeographical Society,* No. 2, 113-125.

*Minchin, D. & J. M. C. Holmes.* A skeleton shrimp *Caprella andreae* Mayer (Crustacea: Amphipoda) new to Ireland, and other strandings in September 1991. *The Irish Naturalists Journal,* 24: 285-286.

*Minchin, D. & D. Jackson. Udonella caligorum* Johnston, 1835 (Platyhelminthes: Udonellidae) associated with caligid copepods on farmed salmon. in G.A Boxshall and D.

Defaye (eds) *Pathogens of wild and farmed fish: Sea lice*. London, Ellis Horwood Ltd. 346-355.

*Minchin, D., & C. Ní Donnachada.* 1994. Optimising scallop sowings for the restocking of an adult population in Mulroy bay, Ireland. *Proceedings of the 8th International Pectinid Workshop.* Ed: J. C. Dao. (in press).

*Moriarty, C.* 1992. (ed.) Papers presented to the 7th Session of the EIFAC Working Party on Eel. *Irish Fisheries Investigations* A 36, pp 152.

*Moriarty, C.* 1992. Catches of *Anguilla anguilla* (L.) elver on the Atlantic coast of Europe 1989-1990. in *Moriarty, C.* 1992. (ed.) Papers presented to the 7th Session of the EIFAC Working Party on Eel. *Irish Fisheries Investigations* A 36, pp 33-34.

*Nunn, J. D.. & D. Minchin,* 1994. *Cuthona genovae* (O'Donoghue, 1926) (Mollusca: Opisthobranchia) from the north coast of Ireland. *The Irish Naturalists Journal* (In press).

*O'Mahony, J.* Shellfish Transfers within the EC - Implications for phytoplankton and other species. *The Phycologist* (in press).

*Poole, W R, J. D. Reynolds and C. Moriarty.* 1992. Age and growth of eel *Anguilla anguilla* (L.) in oligotrophic streams. in *Moriarty, C.* 1992. (ed.) Papers presented to the 7th Session of the EIFAC Working Party on Eel. *Irish Fisheries Investigations* A 36, 72-77.

*Raine, R., T. McMahon and C. Roden.* A review of the summer phytoplankton distribution in Irish coastal waters: a biogeography related to physical oceanography. in M. J. Costelloe and K.S. Kelly (eds). Biogeography of Ireland: Past, present and future. *Occasional Publications in Irish Biogeography* 2, 99-111.

*Silke, J. and D. Jackson.* Harmful and nuisance algal blooms in Irish waters (1990 - 1993). *ICES CM 1993* L:31.

## *CONFERENCE DOCUMENTS*

*Byrne P. & J. H. T. O'Mahony* . Zooplankton-phytoplankton interactions in the Dunkellin Estuary, Western Ireland. *ICES CM 1993* L:19.

*Connolly, P.* The discarding of whiting in the Irish Sea by the Irish Nephrops Fleet. ICES, Northern Shelf Working Group, Aberdeen, June.

*Connolly, P.* The results of the FRC stock monitoring programme for cod, whiting, plaice and sole in VIIa (Irish Sea). ICES, Northern Shelf Working Group, Aberdeen, June.

*Connolly, P.* The results of the FRC stock monitoring programme for cod, whiting, and haddock in ICES VI (Donegal and Rockall). ICES, Northern Shelf Working Group, Aberdeen, June.

*Connolly, P.* The results of the FRC stock monitoring programme for cod, whiting, plaice and sole in Division VIIg (Celtic Sea). ICES, Southern Shelf Working Group, Copenhagen, September.

*Connolly, P.* (Rapporteur) Demersal Committee Report. ICES Statutory Meeting, Dublin, September.

*Doherty, M.* The results of the FRC stock monitoring programme for cod, whiting, plaice and sole in Divisions VIIj,k and VIIb,c. ICES, Southern Shelf Demersal Working Group, Copenhagen, September.

*Doherty, M. & P. Connolly.* Irish estimates of the 1992 landings of hake, monk and megrim by the legal Spanish vessels fishing in Divisions VII and VI. ICES, Southern Shelf Working Group, Copenhagen, September.

*Gillooly, M. J.* Monitoring the marine environment: Present practice - future trends. *Monitoring the environment - future trends.* Conference organised by the International Tyndall School, Carlow, 15-16 September.

*Griffith, D. de G.* Rational fisheries management tpo safeguard the future. Royal Irish Academy seminar 'Conservation of Aquatic Ecosystems', Dublin, February.

*Griffith, D. de G.* Results of the 1992 sea trout research programme. An Taisce symposium on aquaculture, Furbo, March.

*Harvey, M., T. Hayden and N. O' Maoileidigh.* The physiology of salmonid smoltification and implications in the collapse of the sea trout populations in rivers in the west of Ireland. Results of the 1993 analyses. Sea Trout Working Group, FRC, October.

*Hillis, J. P.* Effective management regulation with special reference to the Irish Sea. Irish Sea Forum/Marine Forum Joint Seminar. Liverpool University.

*Hillis, J. P.* Economic aspects of the yield per recruit curve. *ICES CM 1993* D:67 12 pp.

*Hillis, J. P.* Yield, Revenue, Profit and Future Discounting. EAFE Bioeconomics Modelling Workshop. Edinburgh.

*Hillis, J. P. and O. Tully.* Possible advances with the ageing of female *Nephrops* by separation of normal curves in length-frequency distributions. *ICES CM 1993* K:64, 9 pp.

*Hillis, J. P. and O. Tully.* Growth rate, mortality and small mean size in Irish Sea *Nephrops. ICES CM 1993* K:65 13 pp.

*Hillis, J. P. (Joint Rapporteur with N. Bailey and A. C. Jensen).* Shellfish Committee Report, ICES Statutory Meeting, Dublin, September.

*Jackson, D., & D. Minchin.* Variation in sea lice infestation on farmed salmonids in Ireland. *ICES CM 1993* F:30 6 pp.

*Jackson, D., E. Nixon, J. Silke, B. Taaffe & D. Doyle.* The Occurrence of DSP toxicity in Ireland. *ICES CM 1993* F:29

*Jackson, D. and J. Silke. Dinophysis* species in Irish waters 1990 - 1993. *ICES CM 1993* L:30.

*Titov, O.V., T. G. McMahon and R. Raine.* Results of oceanographic investigation in the Northeast Atlantic in Spring, *ICES CM 1993* C:54.

*Minchin, D.* Scallop spat production within sea-loughs by means of induced synchronised spawnings - a possible solution. *ICES CM 1993* F:32. 6 pp.

*Minchin, D., C. B. Duggan, M. Holmes & S. Neiland.* Introductions of exotic species associated with Pacific oyster transfers from France to Ireland. *ICES CM 1993* F:27 11 pp.

*Minchin, D., & D. Jackson.* Studies on *Caligus elongatus* infestations on farmed salmonids in Ireland. *ICES CM 1993* F:31 14 pp.

*Minchin, D., D. Jackson & C. B. Duggan.* Investigations on the nauplii and copepodite stages of the salmon louse *Lepeophtheirus salmonis.* Ministers Sea trout Working Group, Dublin, 18-21 October 1993, 11 pp.

*Molloy, J.* The assessment and management of the Celtic Sea (Div. VIIj) herring stocks. Sherkin Island Research Centre Conference, May.

*Moriarty, C.* The decline in catches of European elver 1980-1992. European Inland Fisheries Advisory Commission Working Party on Eel. 24-29 May, Olsztyn, Poland.

*Neiland, S. and N. Emerson* The RoxAnn System and the Lough Beltra. *Lough Beltra* Workshop, Martin Ryan Institute for Marine Science, Galway, 13-14 April.

*Nixon, E and B. Taaffe.* DSP toxins in Irish mussels and the contribution of a new toxin DTX-2. *ICES* CM/1993/F:28.

*O' Maoileidigh, N.* National sea trout investigations 1990 - 1993. A review of the investigative research programmes and future requirements. Sea Trout Working Group, FRC, October.

*O' Maoileidigh, N., Bond, N. and Doolan, B.* Wild sea trout sampling in East Coast and North West Coast Rivers - May to July, 1993. Sea Trout Working Group, FRC, October.

*O' Maoileidigh, N.* The impacts of the commercial Irish net fisheries on salmon stocks 1981 to 1992. Salmon Management Working Group, FRC, May.

*O'Mahony J. H. T.* Phytoplankton species associated with imports of the Pacific oyster, *Crassostrea gigas,* from France to Ireland. *ICES CM 1993* F:26.

*O'Mahony, J. H. T.* Seasonal Cycle of Phytoplankton in the Dunkellin Estuary, Western Ireland. *ICES CM 1993* L:25.

*O'Mahony, J. H. T.* Spatio-temporal distributions of potentially harmful phytoplankton in the Dunkellin Estuary, Western Ireland. *6th International Conference on Toxic Marine Phytoplankton,* Nantes, France. 18-22 October.

*Scullion, F.* Preventative Medicine in the Aquatic Environment. Sunderland Marine Mutual Insurance Co. Ltd. and Coyle and Hamilton Seminar on Pancreas Disease. Galway, 26 March.

*Tully, O., S. Molloy, P. Gargan, N. O' Maoileidigh, K. Whelan & R. Poole.* Infestation of sea trout *Salmo trutta* L. by the salmon louse *Lepeoptheirus salmonis* Kroyer in Ireland during 1993. *ICES CM 1993* M:14.

## *INTERNATIONAL CONFERENCES*

*ICES Statutory Meeting, Dublin 21 - 28 September.* All staff took part in the work of relevant sections of the Statutory Meeting. D de G Griffith *was President of ICES,* C Moriarty *Chairman of Joint ICES/EIFAC Working Party on Eel; Rapporteurs to Committees* P Connolly *((Demersal Fish),* J P Hillis *(Shellfish),* M O'Sullivan *(Marine Environmental Quality),*

All ICES Working Groups attended issue reports to which the participants make major contributions. These reports contain extensive data from all countries involved in the work. Copies are filed in the FRC library.

*Browne, J.* ICES Dialogue Meeting, Edinburgh, June.
*Browne, J* North Atlantic Salmon Conservation Organisation, Edinburgh, June, London, November.
*Browne, J* Advisory Committee on Fisheries Management, Copenhagen, May, November.
*Connolly, P.* Symposium on otolith Research and Applications. Hilton Head, South Carolina, USA, January.
*Connolly, P.* Maximum Sustainable Yield from Fish Stocks. Cork, Ireland, May.
*Connolly, P.* EC Meeting on Deep Water Fisheries in EC Waters. EC, DGXIV, Brussels, April.
*Connolly, P.* ICES Northern Shelf Working Group. Aberdeen, Scotland, June.
*Connolly, P.* ICES Symposium on Cod and Climate changes. Reykjavik, September.
*Doherty, M.* ICES Southern Shelf Working Group, Copenhagen, September.
*Doherty, M.* Maximum Sustainable Yield and Fish Stocks, Cork, May.
*Doyle, J V.* Standard Advisory Committee for Scientific Advice (SACSA), Oslo Paris Commissions, Oslo, March.
*Doyle, J V.* Irish Sea Co-ordination Group, Dublin, June and November.
*Doyle, J V.* Third Joint Meeting SACSA and TWG, Oslo, March.
*Doyle, J V.* ICES Advisory Committee on Marine Environment, Copenahgen, June.
*Doyle, J V.* North Atlantic Salmon Conservation Organisation, London, November.
*Fahy, E.* Scientific and technical committee for fisheries. European Union, Brussels, September.
*Gillooly, M.* Ad-hoc Working Party of CAN-MAST on Shiptime funding for MAST Projects. Brussels 20-22 October (specialist delegate).
*Griffith, D de G:* Advisory Committee on Marine Science & Technology Programme (MAST), Brussels, January.
*Griffith, D de G:* Regulatory Committee for the specific programme in the field of Agriculture & Agro-Industry, including Fisheries (the AIR Programme), Brussels 8-9 March
*Griffith, D de G:* Drafting application for joint research proposal under the INTERREG Programme with Department of Agriculture for Northern Ireland, Aquatic Sciences Division, Belfast, 20-21 April.
*Griffith, D de G:* 4th Meeting of Directors of Fishery Research Organisations in the European Union, Hirtshals, Denmark, 12-14 May.
*Griffith, D de G:* ad hoc Group of Experts - identification of Priorities for Fisheries Research, Brussels 8-9 November
*Griffith, D de G:* Council of Fisheries Ministers, Brussels 19-21 December
*Griffith, D de G:* David Griffith Planning Committee for 9th ICES Dialogue Meeting, Copenhagen 12 March (as ICES President)
*Griffith, D de G:* Negotiation with national governments of Estonia and Latvia to facilitate their proposed accession to the ICES Convention, Tallinn 22 - 23 March, Riga 24 - 25 March (as ICES President)
*Griffith, D de G:* ICES Dialogue Meeting, organised with the North Atlantic Salmon Conservation Organisation and the International Baltic Sea Fishery Commission: "Atlantic Salmon: A Dialogue", Edinburgh 7 - 8 June (President)
*Griffith, D de G:* Mid-term meeting of ICES Consultative Committee, Copenhagen 14 - 16 June (President)
*Griffith, D de G:* Meeting of Baltic Sea Steering Group, Copenhagen 17 - 18 June (as ICES President)
*Griffith, D de G:* Mid-term meeting of ICES Bureau, Copenhagen 21 - 22 June (President)
*Griffith, D de G:* Symposium on "Cod & Climate Change", Reykjavik 23 - 27 August (as ICES President)
*Griffith, D de G:* Interview candidates for the vacant post of ICES General Secretary, Copenhagen 30 August - 1 September

*Griffith, D de G:* Bilateral talks on ICES-EC co-operation, London 26 November (as ICES President)

*Hillis, J. P.* ICES Working Group on *Nephrops* and *Pandalus* Stocks, Ostend, Belgium, February - March.

*Hillis, J. P.* European Association of Fisheries Economists (EAFE) Annual General Meeting and Conference, Brussels, March.

*Hillis, J. P.* Marine Forum/Irish Sea Forum Joint Seminar on the Irish Sea Fishery. Liverpool, U.K., September

*Hillis, J.P.* EAFE Symposium on Fisheries Management, Edinburgh, UK, November.

*Hillis, J. P.* ICES Study Group on Methods in *Nephrops* research. Aberdeen, UK, November.

*McMahon, T.* ICES/IOC Study Group on the Dynamics of Harmful Algal Blooms. Charleston, South Carolina, USA 8-11 February.

*McMahon, T.* ECOPS conference on the Prediction of Change in Coastal Sea Port d'Albret, France 19-24 June.

*Milne, J.* Working Group on Fisheries Acoustics Science and Technology, Gothenburg, Sweden, 21-22 April.

*Milne, J.* Working Group on Fishing Technology and Fish Behaviour, Gothenburg, Sweden, 19-20 September.

*Minchin, D.* ICES Introductions and transfers of marine organisms, Aberdeen, Scotland, April

*Minchin, D.* EU Concerted Action on scallops, Ardtoe, Scotland, June

*Molloy, J.* The ICES Herring assessment working Group. Copenhagen, 22 March - 2 April

*Molloy, J.* ICES Mackerel and Horse Mackerel assessment working group (Delegate). Copenhagen, 22 June - 2 July.

*Molloy, J.* EC Scientific and Technical Committee for Fisheries (STCF) (Delegate). Brussels, 15 - 17 November.

*Moriarty, C.* European Inland Fisheries Advisory Commission 8th Session of Working Party on Eel (Chairman), 24-29 May, Olsztyn, Poland.

*Neiland, S* Polychaete Colloquium and Workshop. University of Wales, Cardiff, 5-8 April.

*Nixon, E* ICES Marine Chemistry Working Group. Ottawa, Canada, 8-15 February.

*Nixon, E* QUASIMEME Workshop. Portugal, 26 - 31 October.

*O' Maoileidigh N.* International Commission for the Conservation of Atlantic Tuna's Standing Committee for Research and Statistics. Madrid, November 1-5. (Observer).

*O' Maoileidigh, N.* North Atlantic Salmon Working Group. ICES, Copenhagen, March.

*O' Maoileidigh, N.* Study Group on the North East Atlantic Salmon Fisheries. ICES, Copenhagen, March.

*O'Maoileidigh, N.* ICES Workshop on salmon spawning stock targets. Bushmills, 7 - 9 December.

*O'Mahony J. H. T.* DINO-5, 5th International Conference on Modern and Fossil Dinoflagellates , Zeist, the Netherlands 18-24th April 1993.

*O'Mahony J. H. T.* Sixth International Conference on toxic marine phytoplankton. Nantes, France, 18 - 22 October

*O' Sullivan, M.* Eighteenth meeting of the OSPARCOM Joint Monitoring Group, The Hague, January.

*Pfeiffer, N.* Meeting to discuss use of fixed gears in EC waters EC DG XIV. Brussels, 16 - 19 February.

*Pfeiffer, N.* ICES Working Group on Fishing Technology and Fish Behaviour. Gothenburg, Sweden 19 - 20 April.

*Rowe, A* QUASIMEME Workshop. Portugal, 26 - 31 October.

*Silke, J.* Sixth International Conference on toxic marine phytoplankton. Nantes, France, 18 - 22 October.

*Scullion, F.* ICES Special Meeting on Ichtyophorus, Aberdeen, Scotland 21 - 22 January.

*Scullion, F. ICES* Working Group on Pathology and Diseases of Marine Organisms. Copenhagen, 15 - 18 March.

*Scullion, F.* WAWV/SAVA Wildlife Group Symposium on the Capture, Care and Management of Threatened Wild Animals, 14-18 September, Kruger National Park, RSA.

*Smith, M* QUASIMEME Workshop. Portugal, 26 - 31 October.

## *STUDY TOURS and COURSES*

*Coupez, Y.* Sybase course, Dublin, September.
*Gillooly, M.* Broadband Acoustic Doppler Current Profiling Course, RDI Instruments, San Diego, California, 8-12 March.
*Hillis, J. P.* Methods in modelling time paths of catch recovery following improved conservation in over-fished fisheries. Lowestoft, February.
*Hillis, J. P.* Interview survey of Chief Executives of Fish Producer Organisations. Kilkeel, January, and Kirkcudbright, Whitehaven, Fleetwood, Edinburgh and Berwick-on-Tweed, April.
*McGovern, E* Mass Spectrometer Training Course, VG Analytical, 19 - 22 July.
*McGovern, E* Oil Pollution Training Course, Malahide, 2 -5 November.
*Milne, J.* Scottish herring acoustic survey carried out by the research vessel *Scotia* in the North Sea.
*Pfeiffer, N.* Gear technology training and research vessel cruises. Marine Laboratory, Aberdeen, February - March.
*Taaffe, B* Torry Research Station, Aberdeen, Scotland.

## *REPORTS*

*Connolly, P.* A Manual of Fish Stock Assessment Methods. August.
*Connolly, P, M. Doherty, J. Molloy and J. Browne* Fish Stocks in 1992 with Management Advice for 1994, December.
*Cullen, A. , N. Bond, B. Doolan, T. McDermott and N. O' Maoileidigh.* Report of the Coded Wire Tag Returns for 1993.
*Fahy, E.* Towards a programme to manage stocks of whelk *Buccinum undatum* and shrimp *Palaemon serratus.*
*McEvoy, B., N. Bond, and N. O' Maoileidigh.* Video counting of adult salmon at Ardnacrusha fish pass - 1992 report. Prepared for the River Shannon Salmon Management Committee.

CRUISE REPORTS

*Connolly. P.* Irish Sea Young Fish Survey *Lough Beltra.* June and September.
*Connolly, P.* Irish Sea Juvenile Plaice Survey *Sealgair* May.
*Connolly, P.* South Coast Young Fish Survey *Lough Beltra* June.
*Pfeiffer, N.* Square mesh trials *Juliem* 19 July - 6 August.

## *CO-OPERATIVE CRUISES WITH FOREIGN VESSELS*

*Kennedy, D.* - *Veafisk* (Norway): mackerel tagging off southwest, May.
*McMahon, T.* - *Professor Marti* (Russia): blue whiting and oceanography, west of Ireland, April.
Scientists from the *Professor Marti* visited FRC after their cruise.

## *COURSES CONDUCTED BY VISITING EXPERTS*

The first of two STRIDE-funded *Workshops on fish Stock Assessment Methods* was held at the FRC in August. The course was given by Dr Wendy Gabriel (National Oceanographic Association of America, Woods Hole, USA) to FRC staff and focused on modern stock assessment methods such as the analyses of CPUE data, age-based assessment methods, ICES tuning methods for VPA models, running prediction programmes, biological reference points and yield per recruit curves. A manual of methods was produced.